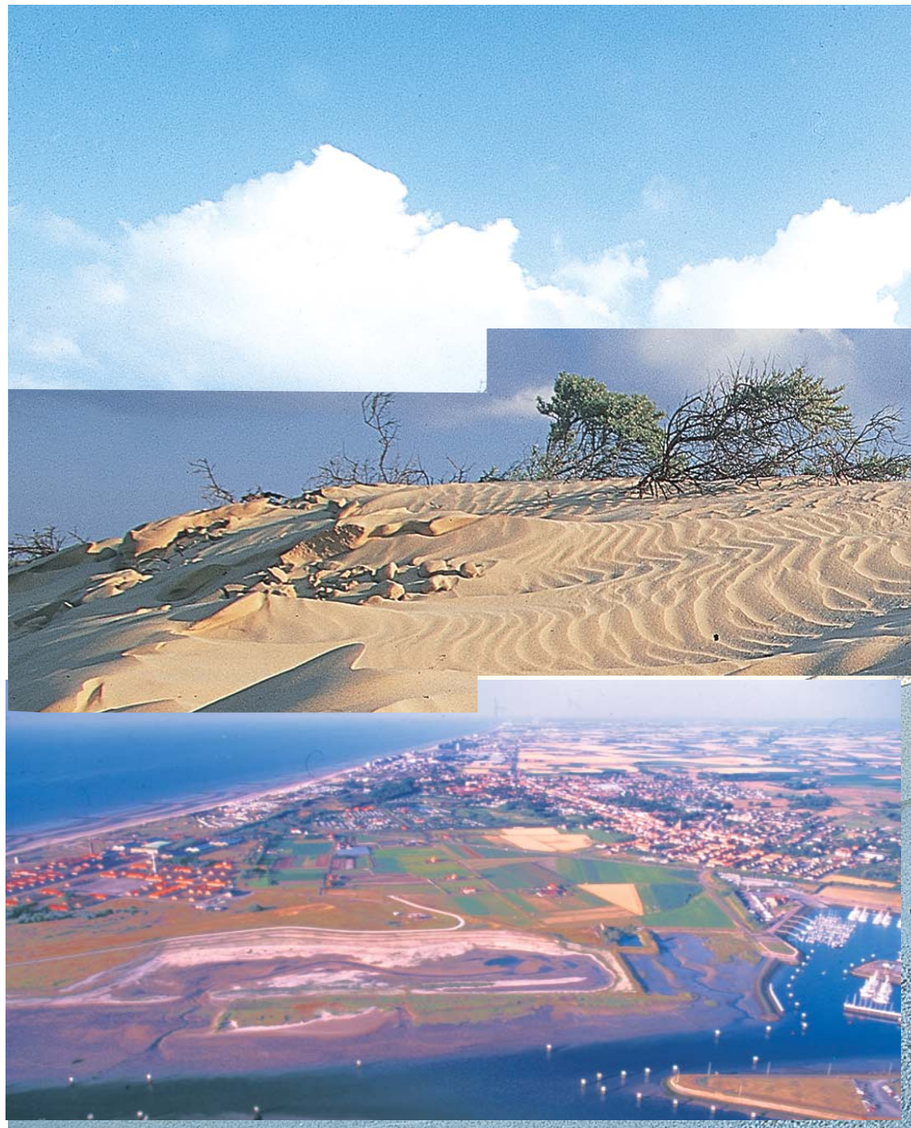
RECOMMENDATIONS RESULTING FROM THE WORKSHOP DISCUSSIONS

DUNES & ESTUARIES 2005



International conference on nature restoration practices in European coastal habitats
Koksijde, Belgium
19-23 September, 2005

Edited by:
J.-L. Herrier,
J. Mees
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International conference on nature restoration practices in European coastal habitats

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Edited by

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Introduction

This publication provides the reader with the major recommendations/conclusions resulting from six interactive workshops taking place during 'Dunes & Estuaries 2005' (19-23 September 2005), the international conference on nature restoration and –development in dunes, estuaries and beaches along Europe's soft-substrate coasts. This conference has been organized – within the framework of the EU LIFE-nature project FEYDRA (Fossil Estuary of the Yzer Dunes Restoration Action) – by the Coastal Conservation Unit of the Flemish Environmental Administration (ANB-Nature), the Flanders Marine Institute (VLIZ), the Coastal Union (EUCC) and the municipality of Koksijde.

The conference has been very successful and clearly fulfilled a need to exchange practical information among the 170 participants from 15 countries, all dealing with coastal conservation and –management. Within the programme of 'Dunes & Estuaries 2005', two blocks of three parallel workshops had been scheduled (below). Within these workshops 3-5 introductory speakers assisted the chair in initiating a discussion focussed on 2-5 major questions/provocative statements.

The introductory presentations have already been published as part of the proceedings of the conference (*cf.* 'Dunes & Estuaries 2005', VLIZ Special Publication 19: http://www.vliz.be/vmdcdata/imis2/ref.php?refid=76346). The results of the discussions, with the answers to the questions, can be found in this publication. The chairs and the rapporteurs acted as the authors of each of the chapters to this publication. Finally, we deduced and highlighted some recommendations from these answers that are considered to be of major interest, and that can be found in the chapter 'Summary: some major recommendations/conclusions'. The list of participants is available on p.52-63.

Workshop programme

BLOCK 1 – Wednesday 21 September 2005

BLOCK 2 – Friday 23 September 2005

SUMMARY

Major recommendations/conclusions

Technical aspects of coastal nature restoration activities and management planning

1. To get dynamics back into a stabilized dune-system in a sustainable way, the initial measures of remobilising the dunes have to be taken on a large enough scale and to be followed up by recurrent measures in the first decade after the initial remobilization. The lack of new sand supply caused by the stabilization of the seafront dunes for coastal protection purposes could on the (very) long run possibly stop the sand-drift dynamics. A warning was given: although sand-drift is a fundamental process in the functioning of coastal dune-systems, **remobilization should not in every situation and every system be regarded as an appropriate management measure**.

2. Management of estuaries should give the river more space. At present, this is often hampered by the economic activities taking place as most important harbours are located in estuaries. Sometimes this restricts the possibilities for nature-restoration and management in estuaries to 'eco-gardening'. In a long term, sea level rise will unavoidably force economic activities to relocate. Therefore, a managed retreat of the coastline should be considered. Especially important in this process is the perception by the public opinion and political decision-makers. **The public opinion and the politicians have to be convinced that giving more space to the river is not only good for nature, but also a necessity for the safety of human populations against floods**. Communication is essential.

3. Everybody agrees that **a decision support tool is useful as long as it keeps to supporting decisions and does not start making decisions**. Decisions should always be based on the best available scientific knowledge but it is impossible to anticipate with full certitude the response of the ecosystem to management measures. So trial and error are to a certain extent unavoidable to build up knowledge from practical experience.

4. We have understood from our French colleagues that they have not abandoned eco-gardening in favour of large-scale mechanical disturbance. Instead they are now using mechanical disturbances besides the eco-gardening. As these mechanical disturbances are not recurrent on the same location, but spread in space as well as in time, dune slacks will not be transformed into lakes. Doubts remain about the choice of just letting vegetation succession progress without interference after the mechanical disturbance was executed.

The role of scientific research in coastal management planning and monitoring

In the workshop on the role of scientific research for nature restoration practices in European coastal and estuarine habitats and in an e-mail forum, scientists, site managers and management planners discussed two major issues.

On the first major question: '*What is the role of scientific research in management planning and how can it contribute most effectively and efficiently?'* the following conclusions were drawn:

1. **An integrated, constantly updated database and meta-analysis of all scientific research that is available at any level and scale would be a strong tool to underpin management planning and realization. To achieve this goal, a professional, permanently staffed *knowledge centre* would be the best approach**. It should not only collect information but also interpret it and make it available in an applicable way, including a help desk function.
2. Academic **research should concentrate on changing processes** within the ecosystem and the effects of these changes on ecosystem patterns.
3. **Evidence-based conservation planning is urgently needed**. Trial-and-error approaches should be validated through more rigorous reporting on experiences.
4. Academic research should be aiming at generally applicable conclusions, enabling all nature managers to support management, also those working at the local scale. However, integrated higher scale scientific research does not exclude local research to solve local questions.

On the second major question: '*How scientific should monitoring be?'* the following conclusions were drawn:

5. The conclusiveness of monitoring strongly depends on clearly defined, exact and measurable goals. **Management goals should be formulated**, using predefined standards.
6. Management goals **should be based on biodiversity criteria, but should also include process criteria**. Biodiversity criteria should not only be at the species and population level. Higher resolution levels, such as community, landscape structure, and also abiotic variables remain equally important.
7. Local monitoring initiatives should be valid at a higher level too.
8. Monitoring should employ standardized methods to come to generalized conclusions not only valid at the local scale; **standardization is necessary to allow repeated, comparable surveys**.
9. Multi-species monitoring **should also cover less popular phyla and functional groups**, taking into account, their indicator value, monitoring feasibility and cost-efficiency.
10. Monitoring is an everlasting process that **should be installed in a permanent way, urging for long-term funding**.

11. A **multi-species monitoring approach is rather of added value to single area-covering and all-biodiversity monitoring, instead of a full alternative**.
12. The **need for more detailed habitat definitions at a lower resolution level** was expressed, but always within the general definitions as given in the habitat directive.
13. Both **direct measurements and indicator species are valuable tools** for assessment of habitat quality.
14. No general conclusion arose from the discussion on the possibility of deriving habitat quality within a region from a representative sample of all sites of the habitat under consideration.

Hydrology and management of dunes and estuaries

1. The **role of hydrological research and groundwater modelling in dune management is very important**, since one is dealing with a vulnerable dune situation. Investing in detailed hydrological research and groundwater modelling is essential.

2. **Recharge of extracted dune aquifers** (water catchment, drainage, etc.) **by means of infiltration is realisable**.

3. **When the natural hydrological system has already been affected, artificial recharge of treated waste water in dune ecosystems can be given a chance. For hydrological 'natural' dune ecosystems it is not advisable.** Where it comes to EC legislation, it is felt that a more dynamic approach of the Habitat Directive could be beneficial in sufficiently large dune areas to get more recharge programmes of treated waste water accomplished. It is argued that the dune system is not a fixed habitat either.

4. **Knowledge of the fresh-water situation** is crucial for (re)creation of salt marshes.

5. **The removal of shrub** out of the dunes is not only important for ecological reasons, but also for hydrological ones. By decreasing the evapotransporation, more water can infiltrate into the dune soil. **The result will be a higher groundwater level in the dunes**.

Tourism/recreation and nature restoration in coastal dunes

1. **Restricting access for people to certain dune areas, can be a useful tool in balancing biodiversity and social needs**. People should be limited in certain areas

while other areas should be closed during the breeding season. This zoning is also different from place to place, and can change over time.

2. **High-water drift lines can be preserved, and hence the development of embryonic dunes, by protecting them from non-selective, mechanical beach cleaning. This can be achieved by applying a zoning** (e.g. by restricting mechanical, non-selective beach cleaning to the most visited beaches and the summer period) and by taking into account the various uses of the beach.

3. The way people feel about shifting sand in dune areas, depends on many things. Open sandy areas with shifting sand are often appreciated as 'wild' nature, a positive attitude that is linked to the fact that the people concerned do not experience any threat. However, when sand reaches nearby houses, the inhabitants often feel annoyed and ask for measures to stabilize the shifting sand. The main conclusion seems to be that, **where possible, shifting sand should be allowed, compensating for areas where local hinder requires stabilization of dunes**.

4. The main question is how to achieve a proper, sustainable management of dune areas in which biodiversity is protected and stimulated in an optimal way, tourists are allowed to enjoy the landscape – where possible – and management actions can be restricted as much as possible.

5. **Particularly in restoration processes of special historical coastal landscapes, it is important to harmonize the historical, archaeological, cultural and ecological values** as much as possible. This can be achieved by carefully planning the restoration process, and taking into account all available information from various points of view.

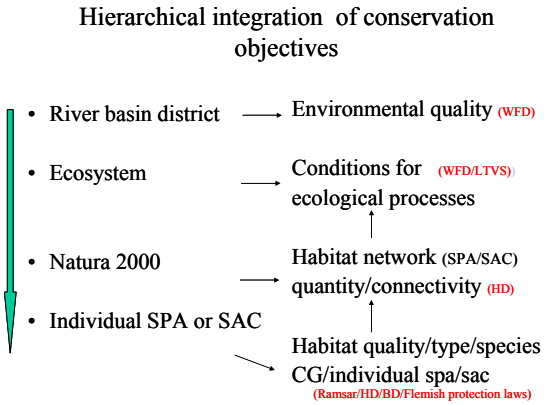
Nature restoration/development in harbours

1. It is **important to define precise relatively high** (to accommodate possible new colonisations) **conservation objectives, and designate a large area for these objectives**. That gives you certainties and flexibility, important for industry, and more nature than you would have with the 'old' conservation objectives that do not take into account possible new colonisations. These new conservation objectives would also have to include objectives for species that are not present in the area yet, may even never have been present there before. In the management plan it can be specified that a certain area (e.g. 5%, without specifying the exact locations, they may vary in time) is allocated to such new developments. Within this area **dynamic planning can be part of the management, while meeting the objectives** is guarded by a network manager (often the port authority). This concept is particularly useful for mobile pioneer species such as coastal birds. For species such as orchids the Management Plan should be location-specific. It is not a solution to focus only on the national perspective and allow deterioration in a specific SPA/SAC because it does

not affect the national objectives, for instance because it is counterbalanced by an improvement in another SAC/SPA. Each country is responsible for reaching a favourable conservation status for each SPA/SAC that has been designated.

2. **Conservation banking is a promising line of thinking, as long as it is firmly based on/closely tied to the conservation objectives and the normal procedures of the BHDs are obeyed**, such as appropriate assessment. The latter is important since compensation should only be considered as a last resort, legally/formally, but also ecologically for the very reason that it appears that compensation is often not sufficiently effective.

3. The definition of quantitative goals in terms of underlying physical, chemical and biological processes is the ideal. **It has the advantages of quantification and does justice to the dynamic nature of many estuaries. Harbours in estuaries are subject to several juridical commitments (Water Framework Directive - WFD, BHD, local (inter)national initiatives), each with its own objectives**. A promising approach is to set goals in an integrated, hierarchical approach, **starting with (1) the river basin district (WFD), via the (2) ecosystem/Natura 2000 netwerk-level to (3) the individual SAC/SPA. An example of such a scheme has been applied to the Scheldt Estuary (and has as such been adopted by the Flemish Government)**.



It starts from an ecosystem view and sets objectives on all levels that are necessary to guard a full functionality of the ecosystem. These can be processes as well as habitats or species. Objectives should be set on all levels, but can in some cases be translated into objectives at a higher level. The same applies to **restoration measures**: they **should not be aiming at restoring specific populations** (example: creation of nesting islands) **or habitats, but at restoring the physical processes that generate the required habitats and populations of species**.

4. A **full-time coordinating team is a key-factor** for the success of management plans and integrative monitoring.

5. **An international monitoring scheme might be very cost effective.** For instance: it would be possible to select representative sites/projects for detailed monitoring, and to implement less intensive monitoring in other sites (less intensive, but sufficient to report to the EU about the conservation status). That might be cheaper than if each country develops it own monitoring scheme.

Shoreline management

1. **Climatic changes and their consequences such as sea level rise are inevitable**. During the last years, dramatic changes have been occurring worldwide, most of them with heavy social and economic impacts. The case of New Orleans, USA, last year, was given as an example of the human vulnerability when confronted with natural disasters.

2. **The engineering solutions against coastal erosion and for sea defence that were long believed as the right ones, must be re-evaluated** as they are very costly and inadequate to contain natural disasters in the future. The case of the Delta project in The Netherlands, was cited as an example of a very costly and unmanageable solution. Fixed set back lines are not sustainable and are very expensive.

3. **To acquire coastal areas for gaining coastal resilience is expensive at short-term, but no more so than engineering defence structures that** in addition to their costs, **need periodic maintenance and have many negative impacts**. The case of the 'Conservatoire du Littoral' in France was given as a good example.

4. Scale is very important in the approach of the coastal issues. Short, medium and long (temporal and spatial) scales of an issue are very different. Large and international estuaries cannot be considered in the same way as local small harbours. The economical perspective of large, international harbours, are the concern of several countries (or the whole EU), so **the role of big companies as stakeholders at an international level should be accounted for in an economic perspective**.

5. The time for change has arrived. **There is a need to replace old concepts about hard engineering to soft, sustainability engineering, based on conservation practises**. The perception of a natural global change scenario and the improved understanding about coastal processes, imply a trend to ecosystem approaches and wise application of knowledge to more sustainable coastal approaches. However, **social impacts on local communities must be considered**. So, a correct long-term cost-benefits analysis is fundamental. Disaster funding are also very important economic skills for local communities, obliged to change life styles.

6. Despite its impact, **artificial nourishment to fight against coastal erosion and loss of beaches, should be preferred to engineering defence structures** which are much more harmful.

7. It is fundamental that all the involved coastal actors from different countries arrive to **imaginative solutions** so that societies can pick them up and include them in their plans, projects and management issues. There is not a single good solution. Compromises **on a case-by-case basis and with the involvement of local communities are needed**. It is important to have an international policy but also to take into account local issues. Coastal zones are not the same everywhere. The involvement of communities and the quality of the local policy are of the highest importance.

8. It is time to change and to move to conservation approaches. No more defence structures, no more abuses, and no more repeated mistakes. **We need to learn from natural coastal dynamics**, while it is still time!

WORKSHOPS

Titles of introductory statements,
major questions/provocative statements and
answers/discussions/conclusions

Workshop 1 – Technical aspects of coastal nature restoration activities and management planning

Chair: Jean-Louis Herrier
Rapporteur: Hannah Van Nieuwenhuyse

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Introductory statements *(for full-text articles see Proceedings)*

1. Dynamic dune management in practice – remobilization of coastal dunes in the National Park Zuid-Kennemerland in the Netherlands (*Terlouw & Slings*)
2. Multi-technique survey of fine sediment transport and deposition in a managed estuary: the Authie Estuary, northern France (*Marion* et al.)
3. Development of a decision support system for LIFE-Nature and similar projects: from trial-and-error to knowledge based nature management (*Brouwer* et al.)
4. Managing the Flemish dunes: from eco-gardening to mechanical disturbances created by bulldozers (*Lemoine & Faucon*)

Major questions/provocative statements

1. Until recently, ***artificially fixing the sand drift*** in the coastal dunes by planting Marram grass (*Ammophila arenaria*) and banishing grazers was a nearly obsessive activity of most coastal dune-managers. Now, stimulating or even mechanically creating (new) dynamics in the fixed dunes seems to become the new hype for dune-managers. But is this remobilization, that often implies the active destruction of valuable 'grey dune' and scrub, on the long run a useful and sustainable option, taking into consideration the possibility that climate change and increased atmospheric deposition accelerate the spontaneous colonization of bare sands by the vegetation, especially by Marram grass?

2. A '***managed estuary',*** isn't that a contradictio in terminis, as an estuary should develop, change and roam freely, governed by water, winds and tides only?

3. Does the fear for failure justify the development of '***decision support tools'***, a development that risks to paralyse or indefinitely delay intended actions of nature restoration? How many years or decades are needed to acquire a full understanding of the functioning of a whole ecosystem? Columbus did not have a 'decision support

tool' when he embarked on his journey to discover a new maritime navigation way to India...

4. Are these 'mechanical disturbances', especially when they need to be repeated in time, on the long run not transforming dune slacks into lakes? Shouldn't we accept that along some stretches of coast – such as that of Belgium and the easternmost part of northern France – the remaining not built upon space has become too limited to allow large-scale dynamics, so that ***'eco-gardening'*** is the only sustainable and advisable tool to maintain or restore biodiversity?

5. Nature management in coastal dunes and salt marshes is a widely spread practice among most European coastal nations, but what about ***nature management of tidal sandy beaches and their subtidal extensions***?

Discussion/answers to questions

1. Is remobilization of dunes a useful and sustainable option?

(based upon introductory statement 1)

Discussion

Jean Favennec states that the key for keeping the dune-systems mobile lies in maintaining the supply of sand of marine origin from the sea-wall. There is a contradiction between the urge of keeping dune-systems mobile and the general policy of precisely stabilizing foredunes and keeping the coastline on its place. Public opinion does not accept the mobility of the coastline because of reasons of coastal protection. The result of this is that dune-managers are on most places constricted to eco-gardening, whether they like it or not. Mobile dune-systems are only sustainable in natural areas that are very large, like Slavinsky National Park in Poland.

Marc Leten does not agree with the view that sand-supply from the sea-wall is the prime condition for sustainable mobile dune-systems. He argues that the central drifting dune of the 'Westhoek' at the Belgian coast (an area of 80 hectares) probably has developed at the beginning of the 19th century by destabilization of a formerly stabilized inner dune-system. This huge drifting sand dune has kept its dynamics for two hundred years independently from the seafront dunes and without any sand supply from the beach. Only in recent years a decrease in dynamics has occurred, probably due to climate change or the decimation of the rabbit population.

Haim Tsoar thinks that people do like the landscape offered by huge areas of bare sand. There are also ecological reasons why sand drift dynamics should be maintained, such as the conservation of a specialised xerophilic and psammophilic fauna. The question that has to be asked is how much vegetation do we have to remove to keep sand drift alive? Along European coasts, dune systems show a tendency to be increasingly stabilized by vegetation. A possible explanation for that is climate change. There has been an increase in rainfall registered from 700 mm to 900 mm. But this cannot explain entirely the

observed increase in vegetation. Probably part of the explanation lies in a possible change in wind-pattern.

Paul Rooney asks what the meaning is of concepts like 'sustainability' or 'natural'. Important for dune-managers is to realize – as Peterken has pointed out – that there is a 'past natural', a 'present natural' and a 'future natural' situation.

Patrick Doody agrees that the availability of sediment together with wind-patterns are essential elements in the dynamics of most dune-systems, but points out that in Finland and elsewhere in the Baltic region there are huge mobile dune-systems without any connection to the sea. Anyway, there is not one dune-system in Europe that has not been influenced by human activity and probably lot of sand drifts resulted from human activity. Although it could be interesting to keep sand drift dynamics in some areas, he warns that it would be dangerous to come to the conclusion that destabilization has to take place everywhere. Sometimes our preference goes to the maintenance of grey dunes instead of the restoration of sand drift.

John Houston asks how fast the Dutch large dune destabilization projects are stabilizing again.

Bas Arens answers that this is a matter of scale. There are parts that stabilize quite fast and others that do not. The reactivation of sand drift has to be over-dimensioned to be sustainable. If you want to restore sand drift for decades, huge areas have to be destabilized. Also in the first period after the initial destabilization, there has to be an intervention every other year to keep the dynamics going. The main problem for the sustainability of restored sand drift is the occurrence of roots in the soil. He also thinks that sand supply from a dynamic seafront is not really needed for the maintenance of a mobile dune landscape, and points to the example of the Rabjerg Mille in Denmark.

Marc Leten reminds that the aims of remobilization of dune-systems are not limited to reactivate sand drift as such but are also to allow the development of new blow-outs and eventually wet dune slacks. One of the first pioneer species that appears in wet dune slacks is Sea-Buckthorn. To maintain biodiversity in the newly formed wet dune slacks, more classical management tools, such as weeding seedlings of shrubs and trees or mowing, are needed. It is clear that remobilization on its own is not sufficient for the restoration or maintenance of biodiversity in a dune system.

Conclusions

To get dynamics back into a stabilized dune-system in a sustainable way, the initial measures of remobilizing the dunes have to be taken on a large enough scale and to be followed up by recurrent measures in the first decade after the initial remobilization. The lack of new sand supply caused by the stabilization of the seafront dunes for coastal protection purposes could on the (very) long run possibly stop the sand-drift dynamics. A warning was given: although sand-drift is a fundamental process in the functioning of coastal dune-systems, remobilization should not in every situation and every system be regarded as an appropriate management measure.

2. A 'managed estuary', isn't that a contradiction in terminis, as an estuary should develop, change and roam freely, governed by water, winds and tides only? *(based upon introductory statement 2)*

Discussion

Roger Morris mentions that the present natural driving forces of estuaries are affected by climate change and sea level rise. That makes it necessary to manage estuaries, not only from a conservation point of view but also for human purposes. In estuaries extreme actions will be needed.

Robert Jentink points out that in the Netherlands there are no more natural estuaries. All big stream-mouths are adjacent to large harbours. The presence of harbours limits the possibilities for allowing natural patterns and processes in the estuaries. The Westerschelde was once a large estuary, but its course is now not natural anymore: the river is no longer free to go where it wants to go. Active management, call it eco-gardening, is needed to maintain or restore salt marshes in a controlled estuarine environment.

Geert Raeymaekers reminds that the European Habitat Directive urges the member-states to keep (or restore) the estuarine habitats in a favourable state of conservation. This could imply that the space where estuarine processes can occur should be increased. The management of estuarine systems should not be reduced to just a static eco-gardening.

Stephen Worrall says that, taking into account the effects of geomorphology and climate change, estuaries might in the future be less managed. The present management actions should be designed to allow the estuaries to manage themselves in the future.

Claire Marion observes that estuaries are very attractive to humans for economic activities that are often not compatible with the ecological functioning of the estuary. Problems are caused by the large scale of natural processes and the local scale of political decisions. As an example, politicians will quickly decide upon actions to stop erosion, but in doing that will not take into account the possible consequences of their actions for the natural functioning of the estuary on a larger scale. Local actions that were not well-prepared, often displace instead of solve the problems. A better understanding of the global functioning of the estuary is necessary for a more appropriate management.

Rogier Kuil says that the maintenance of a 'completely' natural system is only possible in small estuaries. The industrial and other human activities in the large estuaries limit the possibility for nature development in these large estuaries to eco-gardening. But this should not be negatively perceived: a great biodiversity can be achieved on even a small scale.

Roger Morris does not agree with that point of view. In large estuaries large-scale works into nature development are being executed, for instance in the estuary of the Humber.

Stephen Worrall points out that political decisions are often taken on a short term, while the management of an estuary needs a long-term vision. In the UK, the time horizons on which estuaries are managed are being extended to hundreds of years. Fixing an estuary for actual economic interests is asking for trouble. Economic activities should be relocated to give more space to the river.

Robert Jentink answers that in the Netherlands it proofs to be very difficult to convince people that land should be given back to the sea or that an estuary should be given more room. Even when action is needed for their own safety, inhabitants of the water catchment area are usually firmly opposed to such plans.

Stephen Worrall emphasizes that port industries should in their own interest shift from the present short-term management to long-term vision and management**.**

Pat Doody remembers a cartoon about climate change on which Saint Paul's cathedral is immersed. The barrage on the River Thames can only resist a 400 years event. The dikes in the Netherlands are designed to resist a 4000 years storm. But the more the defences against flooding are being raised, the more catastrophic the results of a more than 4000 years event will be. We have to make politicians understand that in the wake of the sea level rise, defences against flooding cannot be raised up indefinitely. Relocation of activities is necessary for human safety.

Conclusions

Management of estuaries should give the river more space. At present, this is often hampered by the economic activities taking place as most important harbours are located in estuaries. Sometimes this restricts the possibilities for nature-restoration and management in estuaries to 'eco-gardening'. In a long term, sea level rise will unavoidably force economic activities to relocate. Therefore, a managed retreat of the coastline should be considered. Especially important in this process is the perception by the public opinion and political decision-makers. The public opinion and the politicians have to be convinced that giving more space to the river is not only good for nature, but also a necessity for the safety of human populations against floods. Communication is essential.

3. Does the fear for failure justify the development of decision support tools? *(based upon introductory statement 3)*

Explanation

Does the fear for failure justify the development of a 'decision support tool' that risks to paralyse or indefinitely delay intended actions of nature restoration? How many years or decades are needed to acquire a full understanding of the functioning of a whole ecosystem? Columbus did not have a 'decision support tool' at his disposition when he embarked on his journey to discover a new maritime navigation way to India … As everybody knows he failed to reach India, but discovered the Americas. Was such a 'failure' not worth a trial?

Discussion

Gert-Jan van Duinen explains that there is a need of exchange of information between scientists of different disciplines and countries, and that decision support systems can help to make this information easily available. He illustrates his statement by different examples of unsuccessful nature management actions: the restoration of ponds for the Natterjack toad (*Bufo calamita*), dismissing the need of sufficient terrestrial habitat for feeding, and the failing management of some grasslands and heather that kept on degrading under the influence of atmospheric deposition of nutrients. A decision support system should help not to forget any essential factor.

Jean-Louis Herrier wonders whether the fact that restoring some ponds was not a success for the Natterjack toad has to lead us to regret the creation of those ponds. Undoubtedly those ponds will have been favourable for other species, such as aquatic plants and insects. Even if the initial main objective is not reached, other spin-offs of the action can make the effort worth while. Will the yearning for certitude through a decision support tool not lead to a stand-still?

Robert Jentinck thinks that a decision support tool could be helpful, but also that it is a good thing to learn from mistakes that have been made. He pleads for a tool that would be a support system, but not a decision system. It must not become something on which we rely totally so that we will not dare to try new things anymore.

Geert Raeymaekers pleads for trial and error.

Jean-Louis Herrier points out that monitoring the trial and error allows to acquire the necessary knowledge to avoid errors in the future.

Marc Leten compares the decision support tool with a cooking book, but a cooking book for a restaurant that will not obtain a star in the Michelin guide. The present legislation, especially the European Bird and Habitat Directives, are favouring cooking book methods in nature management. To get European funding, nature management actions have to target species from the annexes of the European directives (e.g. the already mentioned Natterjack toad). In that way managers tend to loose an overall view

of the functioning of the whole ecosystem, which should be the main focus for the managers.

Jean-Louis Herrier points to different approaches in different countries. In the UK, a lot of attention goes to species, while in Flanders nature management is mainly inspired by target-habitats. But lists of target habitats can also lead to a cooking book approach.

John Houston is aware of the fact that in the UK too much attention seems to go to the maintenance of some rare species. But most of the time the target species that are chosen are indicator species for the state of the ecosystem and their maintenance status tells us more about the biodiversity that is typical for the physical environment in which the indicator species occur. There is a difference between what one studies and what one presents.

Jean-Louis Herrier reminds to the subject of the discussion: a decision support tool. To illustrate his fear about an abusive way of decision support tools, he gives the example of the partially failed demolition-project of the Home Theunis in the nature reserve of 'Ter Yde' at Oostduinkerke (Belgium). One of the objectives of the demolition of this building was the restoration of sand drift. But a couple of years after demolition took place, the sand drift was stopped by the accumulation of small debris on the surface of the site where once the building had stood. On the other hand where the building once stood, the open space is now restored, rainwater is allowed to infiltrate the sandy soil, dune plant species grow, wheatears forage, disturbance of the natural area by inhabitants or visitors of the former building is avoided etc.. If we had a decision support tool at our disposition, perhaps the uncertainty about the feasibility of restoring the sand drift would have kept us doubting about the usefulness of demolishing the building. Because of those doubts the building would perhaps never have been demolished and nature would not have had the other benefits of the demolition.

Haim Tsoar asks how many years are needed to fully understand an ecosystem? Most field-studies just last only 3 to 4 years and then conclusions have to be reached. But the reaction of the system upon an action takes often much more time. There is a need for long-term ecological research and for long-term monitoring over the whole world, to be able to give an answer to questions such as what is the reaction of the system to climate change.

Paul Rooney pleads for building up knowledge by collecting information about trial and error through networking. Exchanges of papers about the results of Life–projects are one way of exchanging and building collective knowledge.

Freek Zwart emphasizes the importance of trial and error. The management of the island of Terschelling (the Netherlands) consists of 30 years of trial and error and the results of this are satisfactory. Nature management should not be reduced to a kind of building-contract. It is impossible to predict everything. Nature managers have to accept that the final outcome of management actions can never be fully predicted and to trust on the green fingers of skilled personnel on the site.

Conclusions

Everybody agrees that a decision support tool is useful as long as it keeps to supporting decisions and does not start making decisions. Decisions should always be based on the best available scientific knowledge but it is impossible to anticipate with full certitude the response of the ecosystem to management measures. So trial and error are to a certain extent unavoidable to build up knowledge from practical experience.

4. Is eco-gardening preferable to large-scale mechanical disturbances in order to maintain or restore biodiversity in small-scale dune areas? *(based upon introductory statement 4)*

Explanation

Are these 'mechanical disturbances', especially when they need to be repeated in time, on the long run not transforming dune slacks into lakes? Shouldn't we accept that along some stretches of coast – such as that of Belgium and the easternmost part of northern France – the remaining not built upon space has become too limited to allow large-scale dynamics, so that 'eco-gardening' is the only sustainable and advisable tool to maintain or restore biodiversity?

Discussion

Jean Favennec points to the importance of scale. In some parts of France, conservationists try to remobilize a fixed dune (where there is enough space left for allowing the dune to get on the move), while in some other places local communities want to stabilize mobile dunes that threaten buildings or roads. It is necessary to have a global vision.

Leon Terlouw is afraid that repetitive excavations on the same spot could turn humid slacks into lakes. It is not only necessary to differentiate management-tools according to the scale, but also to differentiate them in time.

Marc Leten agrees that mechanical methods could be equivalent to large-scale natural processes such as marine intrusions and sand drift, but points out that these excavation measures have to be followed up by eco-gardening. If we just excavate an area, quite rapidly the resulting (artificially restored) wet dune-slack will be invaded by Sea-Buckthorn that will supersede the target pioneering species and habitats. To give the pioneering species and habitats a chance to last for more than just a couple of years, weeding the seedlings of Sea-Buckthorn and mowing young scrub will be needed. He wonders whether the space is available to start excavating a new dune-slack every time an older dune slack has been overgrown by shrubs.

Paul Rooney reminds us that coastal dunes are an anthropogenic landscape and that this fact allows us to show some creativity in the approaches of managing the dunes. He asks what we want to obtain on the long term and how we do sell our 'products' to the

European Commission. He warns not to let nature management get into a legal based straight-Jacket.

Jean Favennec says that larger areas can be managed in a less interventionist way, while smaller sites can need a more intensive type of management.

Guillaume Lemoine clarifies that the excavations taking place in some French dune areas are not repeated on the same spot. Slacks do not risk to be changed into lakes, after all. Excavations are executed on different locations all 10 to 15 years in order to have different stages in vegetation-succession on different locations within the managed area. Besides these excavations, eco-gardening is still carried on for other locations that have been managed by cutting and mowing for a longer time.

Conclusions

We have understood from our French colleagues that they have not abandoned eco-gardening in favour of large-scale mechanical disturbance. Instead they are now using mechanical disturbances besides the eco-gardening. As these mechanical disturbances are not recurrent on the same location, but spread in space as well as in time, dune slacks will not be transformed into lakes. Doubts remain about the choice of just letting vegetation succession progress without interference after the mechanical disturbance was executed.

5. Nature management of tidal and subtidal zones of sandy beaches

As there were no marine biologists present in this workshop, the aspect of controlling exotic invaders was but briefly mentioned. An important statement, made by **John Houston** and **Geert Raeymaekers**, is that efforts should be made to integrate scientific research and monitoring of geomorphological processes at sea and on shore. More precisely the attention should be drawn to the relation between the formation of tidal sandflats in the shallows and dune formation on sandy beaches, as well as to the exchange of sediments between shallows and the beach.

Workshop 2 – On the role of scientific research for nature restoration practices in European coastal and estuarine habitats

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Introductory statements *(for full-text articles see Proceedings)*

1. Are coastal dune management actions for biodiversity restoration and conservation underpinned by internationally published scientific research? (*Bonte & Hoffmann*)
   The authors stated that: (1) the internationally published research, focussing on coastal dunes and their management, is limited; (2) many studies focus on local questions and are therefore difficult to generalize; (3) scientific research should focus on deteriorating processes and aim at generalizations.
2. Donkeys as mobile links for plant seed dispersal in coastal dune ecosystems (*Couvreur* et al.)
   As demonstrated by the author, this type of rather specialized research can directly or indirectly contribute to nature management; adding up results of this kind of research can help nature management decisions significantly.
3. Towards integrated monitoring along ecological gradients: the example of the IJzermonding (*Hoffmann* et al.)
   Emphasizing several problems of a scientifically sound monitoring approach, the author stressed the need for clear-cut initial management goals, monitoring method standardization, data integration, and the persistent interaction between monitoring and nature management fine-tuning in function of goals.
4. Monitoring Bryophyte and Lichen dynamics in sand dunes (*Rozé & Jun*)
   The authors demonstrated that integrating biological data at a more generic level, in this case of functional groups, helps to understand succession processes in dune ecosystems, and, hence, helps to underpin nature management measures.

5. Cascading effects of atmospheric nitrogen deposition on coastal dunes along the Baltic Sea (*Esselink*)
   In this presentation the importance of first identifying the real causes (processes) – that determine changing patterns – before taking management decisions, was stressed. The example was given of the impact of atmospheric nitrogen deposition, being largely responsible for graminoid dominance in dunes areas along the Baltic Sea coast.

Major questions/provocative statements

Based on the introductory communications, two major questions were derived:
- What is the role of scientific research in management planning and how can it contribute most effectively and efficiently? This question was looked at from the manager's and from the researcher's point of view.
- How scientific should monitoring be?

Discussion/answers to questions

These major questions were discussed, using several statements. The first question, and its statements, was discussed during the workshop, and afterwards through e-mail comments. Since the second question could not be treated during the workshop, the comments were collected through e-mail. A summary of the discussion is presented. For each statement the main comments are briefly described. For the second question also the number of e-mail correspondents per statement is given. A conclusion per statement, agreeing with the majority of comments, is formulated.

1. What is the role of scientific research in nature management planning and how can it contribute most effectively and efficiently?

From the manager's perspective

Statement/discussion

Evidence-based conservation planning is urgently needed and should replace 'trial-and-error' approaches as much as possible.
- Trial-and-error approaches are acceptable, but should always be reported upon, allowing practitioners and scientists to learn from it.
- Managers should be given time to report on their experiences, preferably in written form.
- Workshops and meetings between managers and scientists should contribute to further improvement of coastal and estuarine nature management.

Conclusion

Both evidence-based and experience-based approaches are valuable, but for the latter more rigorous reporting is needed.

Statement/discussion

An integrated, constantly updated database and meta-analysis of all scientific research that is available at any level (from the international up to the local report level) would be a strong tool to underpin management planning.

- All available and forthcoming information should be collected in a database. The database should include scientific (academic and non-academic) as well as day-to-day experience of site managers.
- The information in the database should not only be consultable as such, but also interpreted, analyzed and reviewed and prepared to answer questions of management planners and site managers.
- The database should be readily consultable and relevant to site managers, authorities and scientists, whether at the local, the regional, the national or the European scale.
- The knowledge centre should include an (inter)active helpdesk structure to which management questions can be asked.
- Input for research planning is a vital assignment of the knowledge centre, anticipating on the expectations on forthcoming management problems.
- Given the importance of coastal and estuarine management for nature as well as economic and safety reasons, and given the large diversity of coastal regions in Europe, this knowledge centre would preferably be staffed by a permanent group of scientists, data analysts, communication specialists and technical personnel.
- It should be taken into consideration to implement a knowledge centre on nature management in general, but coastal and estuarine management are so specific, that a knowledge centre entirely focussing on those ecosystems is justified.
- Issues of centralized *versus* decentralized structure, final authority and control of the database system were not dealt with during the workshop, but were mentioned in e-mail reactions, with a clear preference for a centralized structure.
- If a permanently staffed knowledge centre would not be reachable on short notice, an on-line, regularly updated handbook on coastal and estuarine management and monitoring could be an alternative.

Conclusion

To achieve the ambitious goal of an integrated, constantly updated database and meta-analysis, a professional, permanently staffed knowledge centre would be the best approach.

From the researcher's perspective

Statement/discussion

Academic research should concentrate on changing processes within the ecosystem and the effects of these changes on ecosystem patterns.

- Long term global processes, such as climate change or atmospheric pollution need special and urgent attention. We need to understand the effects to integrate knowledge into management.
- Early anticipation on forthcoming management questions by scientists and research planners is necessary.

Conclusion

This statement was generally accepted.

Statement/discussion

Academic research should be aiming at generally applicable conclusions, enabling all nature managers to underpin their management, also those working at the local scale.

- This does not exclude local scientific research, but an integrated higher scale level would allow more generic conclusions.
- To solve local problems – scientifically sound, but not necessarily academic – local research will always remain necessary.
- Vital to validate research is the distinction of relevant and objective references.
- Research networking, combining sites that are representative for Europe's eleven biogeographical coastal regions, should be promoted; this does not contradict with the remaining need of local research.

Conclusion

Integrated higher scale scientific research and its networking is vital, though does not exclude local research to solve local questions.

2. How scientific should monitoring be?

This question was answered with a strong plea for scientifically sound monitoring, using clearly defined goals and standardized methods with repeatability and maximum avoidance of faults introduced by the use of different successive observers. A total of 11 respondents participated in the e-mail communication, not necessarily responding to all statements though. Conclusions on monitoring clearly hold for other ecosystems than the coastal and estuarine environment as well.

Statement/discussion

The conclusiveness of monitoring strongly depends on clearly defined goals; hence, these need to be exact and measurable

- It is important that the same standards will be used to define habitat goals by all management planners involved.
- Essential for effective monitoring is a transparent problem definition ('what'), the choice of measuring method ('how'), and with what standards the monitoring results should be compared with ('what is the reference').
- Before management measurements are taken, scientists should be involved in their planning.

Conclusion

The statement was accepted in general by all respondents.

Statement/discussion

Management goals should be formulated, using predefined standards

- It was added that standards should keep the possibility to take unexpected developments into consideration and enable fine-tuning at the local level.
- Standards for primary goals could be helpful. Interdisciplinary stakeholders (practice, research, administration) should work out a set of these. Depending on the complexity of the ecosystem, it may be necessary and advisable to restrict the number of primary goals.

Conclusion

The statement was accepted by the majority of respondents.

Statement/discussion

The level of accuracy of habitat definitions as given in the Habitat Directive is too low to allow valuable pre-definition management goal standards at the European, national, regional and local scale.

- It is necessary to formulate a set of sub-habitats, based on far more accurate habitat definitions than presently available.
- In the case of national, regional or local subdivisions, these should hierarchically fit within the European habitat types.
- One respondent states that habitat typology should be differentiated for each country, making it appropriate for the management goals and local conditions; in the end it should fit within the EU habitat types.

Conclusion

The statement was not unanimously accepted. Generally a need was expressed for more detailed definitions of habitat types at a lower resolution level, but always within the general definitions of the EU habitat types.

Statement/discussion

Management goals should be solely based on biodiversity criteria. Biodiversity criteria should primarily be at the species and population level, not or only secondary on derived variables (such as plant community, landscape structure, benthic community,…)

- Biodiversity, with all its aspects, is indeed the primary target for management. According to the Convention on Biological Diversity, 'biological diversity' means the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
- As is described in the definition of biodiversity, management goals should include the specificity of the habitat type, the local or regional locality under consideration and, e.g. geomorphology.
- Management goals should also include variables at the process level.
- The realization of (a)biotic conditions (pattern and process parameters) and ecological processes is a goal within the biodiversity target.
- Although biodiversity is the primary goal for management, the multifunctional character of coastal areas cannot be neglected (e.g. recreation, safety, environmental functions,…)
- Species communities, landscape structure can be very useful goals, representing habitat function for the desired species.

Conclusion

The statement was not accepted. The importance to also include process criteria was stressed. Biodiversity criteria should not only include the species and population level. Higher resolution levels, such as community, landscape structure, and also abiotic variables remain equally important.

Statement/discussion

Local monitoring initiatives should be valid at a higher (ecosystem, regional, national, European) level too.

- Monitoring should enable conclusions on local biodiversity and management, but also contribute to the knowledge on management effectiveness and the biodiversity status at a higher resolution level.
- Input of the knowledge centre as suggested under major question 1, should substantially help to realize this task.
- Problems might arise if site managers are not concerned with a resolution level that goes beyond their local situation. This stresses the necessity of dialogue with managers and need for training and education.

Conclusion

The statement was generally accepted with some additional remarks.

Statement/discussion

Monitoring should employ standardized methods to come to generalized conclusions, not only valid at the local scale, and to enable repeated surveys that can be compared with neither technical nor observational bias.

- All respondents point at the importance of standardized methods.
- Transparency in the methodology is vital for monitoring on the long run and simplifies the transfer from monitor group to planner and from one monitoring group to the next.
- It is positive to use standardized methods to compare the results, but it is necessary to have some low cost methods, particularly technical equipment. It should be possible to vary the methods considering the habitat type peculiarities or specific questions. It is already helpful to give general recommendations on the methods that can be used.
- Technical standardization is more easily accomplished than observational standardization; sampling should be as observer independent as possible.
- Scientists should normally interpret their results with wise use and should describe the results in such a way that administration and site managers do not misunderstand the results.

Conclusion

The statement was accepted by all respondents with some additional remarks. The need for sound, feasible and standardized methods was generally accepted.

Statement/discussion

Habitat quality would best be measured using indicator species.

- The evaluation of habitat quality highly depends on habitat type; also important is the completeness of taxonomic, functional groups.
- It is important that the indicator species list is sufficiently long; red list species and target species alone are insufficient; preferably indicator species groups across various phyla and complementing habitat requirements should be used.
- The use of indicator species should be combined with direct measurements of structure, physical and chemical variables, geomorphology, etc.
- In some cases, indicator species are a good and low cost alternative. Nonetheless, this does not always exclude the need for detailed ecosystem studies.

Conclusion

Most respondents do not agree with the statement unequivocally, indicating that direct measurements are considered to remain necessary.

Statement/discussion

Habitat quality estimation within a certain region can validly be derived from a representative sample of all sites of the habitat under consideration (not all sites need to be monitored).

- Given the financial and practical limitations, it is better to monitor a representative sample of all habitat types in a scientifically sound way, than cover all localities within a region, using a more superficial method.
- This would be possible at the national level, but site managers primarily have responsibility for their 'own' area; therefore monitoring should be done at the local scale as well.
- This depends on the parameter that is used for describing the habitat quality.

Conclusion

Respondents did not unequivocally agree on this statement; it can therefore not be accepted as such.

Statement/discussion

(Abiotic) conditions should be truly measured instead of estimated through indicator species

- Abiotic variables can be measured in a multitude of ways (e.g. temperature: maxima, minima, mean, daily, etc.); it is not always known though, which one is relevant for a particular species and species may respond differently. This is a strong argument, in favour of using variables that integrate (a)biotic conditions, e.g. the use of indicator species.
- As long as the indicative value of indicator species is sound, it is not necessary to measure an often large (indefinite) package of abiotic variables. It remains nonetheless interesting to register the true abiotic conditions, because the presence or absence of (indicator) species is not always univocally related to abiotic conditions.
- It is important to remain having measurements of abiotic conditions; good criteria are described for the selection of indicator species, however in some situations few species correspond to all these criteria, e.g. some potential indicator species are not sensitive enough or there is a time-lag in their response.
- For many habitats there are still no or few well known indicator species.

Conclusion

Most respondents are in favour of a combination of true measurements and the use of indicator species.

Statement/discussion

A multi-species approach is a valid alternative for area-covering and all-biodiversity-monitoring

- It might be so in some habitat types and regions if it is evidence-based; however, we are not yet able to distinguish multi-species groups for all habitats that need to be monitored; a lot of research is still necessary.
- It should rather be considered as an additional investigation.

Conclusion

The respondents consider a multi-species approach of added value, but not as a single, area-covering and all-biodiversity-monitoring alternative.

Statement/discussion

The multi-species alternative should also cover less popular phyla and functional groups, such as difficult to recognize bryophytes, fungi, detritivores,…

- It should always be preferred to have good indicators, not just easily recognizable or popular ones.
- The statement can be agreed upon, only if these species groups are relevant for management; if not, monitoring risks to become a research goal on its own instead of a tool to help management planning.
- This needs special training of managers.
- A balance between cost and information value remains necessary.
- Often these phyla and functional groups are important for the habitat, and should thus also be covered; it should always be avoided that only one or a few groups are investigated without paying attention to the rest of the ecosystem.

Conclusion

Most respondents agree on this statement, when feasibility is taken into consideration.

Statement/discussion

Monitoring is an everlasting process that should be installed in a permanent way, urging for long-term funding.

- Monitoring should always be as cost-effective as possible; as such it should not be allowed to become a purpose on its own instead of a tool to improve nature management.
- It is an important challenge to construct a monitoring programme that is realistic financially; funding of everlasting or even long-term monitoring is virtually impossible to find.
- Site managers should be convinced that the evaluation of the management is as much of an ongoing process as the management itself, thus underpinning the importance of long term monitoring; also monitoring can be improved during the everlasting process

of management fine-tuning and monitoring; monitoring initiatives on the short term remain valuable as well.

- A maintained interaction between management and monitoring would be magnificent; important is that the studies and the results of one area are coordinated by one institute or administration; also important is that scientists, administrations and managers work more together; this can be achieved through the earlier discussed permanent knowledge centre for (coastal and estuarine) nature management.

Conclusion

Researchers almost unequivocally agree on this statement, most practitioners additionally point at the high cost of monitoring initiatives.

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Workshop 3 – Hydrology and management of dunes and estuaries

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Introductory statements *(for full-text articles see Proceedings)*

1. The role of hydrogeological research in the realization of a combined pumping and deep infiltration system at the excavation 'Duinenabdij' (*Louwyck* et al.)
2. Sustainable groundwater management of a dune aquifer by re-use of wastewater effluent in Flanders, Belgium (*Van Houtte* et al.)
3. The importance of groundwater and other ecohydrological impacts in the management of salt marsh plant communities (*Boorman & Hazelden*)
4. Supporting dune management by quantitative estimation of evapotranspiration (*Samson* et al.)

Major questions/statements

1. The ***role of hydrogeological research and groundwater modelling*** in dune management is very important.
2. Is ***recharge of extracted dune aquifers*** (water catchment, drainage, etc.) by means of infiltration realizable?
3. Can ***artificial recharge of treated waste water*** be beneficial to the dune ecosystem? And does EC-legislation hinder this?
4. For (re)creation of salt marshes, ***knowledge of the fresh-water situation*** is crucial.
5. Will a good quantitative estimation of ***evapotranspiration*** of various vegetation types lead to changes in dune management?

Discussion/answers to questions

1. The role of hydrological research and groundwater modelling

(based upon introductory statement 1)

Discussion

Roeland Samson: (Q) Has the used model already been calibrated? (A) Not yet, because we were not involved in the following up of the drainage system. However, the model has been calibrated with a double pumping test and under the assumption of homogeneity of the concerned permeable and semi-permeable layers. This should be sufficient to guarantee an efficient functioning of the system.

Ralf Gyselings: (Q) Is the underground very homogeneous or heterogeneous, and how is this presented in the hydrological model? (A) The situation in 'Duinenabdij' is quite homogeneous, which is confirmed by the various borehole descriptions and the geophysical borehole measurements. Based on these data, the studied groundwater reservoir was schematised in three permeable layers, separated by two semi-permeable layers. Below, the aquifer is bounded by a Tertiary clay layer which was considered impervious in this study.

Luc Geelen: (Q) Is there also a rise of the freatic groundwater level measured/calculated? (A) The influence area is only dune area, and a moistening of the soil is favourable in this area. Furthermore, this rise is kept small by letting the infiltration happen in a deep aquifer, under the uppermost semi-permeable layer.

Arjen Kok: (Q) The aim to use a hydrological model is of course to calculate the drawdown of the hydraulic head in the different aquifers. Has there been also research on the effects of changing the water quality? (A) The studied aquifer only contains fresh water. The extracted water is immediately deep infiltrated by means of a 'closed' system, which prevents the water to oxidize.

Piet Veel: (Q) Without modelling, what would have happened? (A) Modelling the system enabled us to find the optimal well configuration and to estimate the required discharges. Without modelling one risks an overestimation or underestimation of these discharges and 'too dry' or 'too wet' circumstances as a consequence.

Laurence Boorman: (Q) Has there been any interaction between surface and groundwater? What was the size/scale of the model? (A) There is no relation between surface and groundwater. The scale of the model is 1 by 1 km.

Conclusion

The role of hydrological research and groundwater modelling in dune management is very important, since one is dealing with a vulnerable dune situation. Investing in detailed hydrological research and groundwater modelling is essential.

2. Is recharge of extracted dune aquifers (water catchment, drainage, etc.) by means of infiltration realizable? *(based upon introductory statement 2)*

Discussion

Roeland Samson: (Q) Is the infiltration system cost effective, what are the costs? (A) Costs: 250,000 EUR drilling and infrastructure, 2,500 EUR energy, 50,000 EUR preliminary studies (which include the construction of observation wells, the performance and interpretation of geophysical borehole measurements, the performance and interpretation of the double pumping test, and the modelling of the combined system of pumping and deep infiltration). Note that the wells constructed for the pumping test were used in this drainage system afterwards.

Luc Geelen: (Q) Is there a difference in the fluctuation of the groundwater table during summer and wintertime? (A) The water table level is at a minimum by the end of the summer and at a maximum by the end of the winter. As a consequence, draining the site is particularly needed during winter. The difference between the mean level in September 2000 and May 2001 was about 1.5 m. The drainage system is constructed as flexible as necessary to meet these fluctuations.

Conclusion

Recharge of extracted dune aquifers (water catchment, drainage, etc.) by means of infiltration is realizable.

3. Can artificial recharge of treated waste water be beneficial to the dune ecosystem and does EC-legislation hinder this? *(based upon introductory statement 2)*

Discussion

Luc Geelen: (Q) This is a unique situation, has it ever been considered to combine this with a deep infiltration system. (A) Not really.
(Q) Catchment is now at the outside of the infiltration system. Is it possible to have a zero effect outside by combining the technique shown in the previous lecture and this project?
(A) At this time, prevention of spreading of the infiltration water had priority. By infiltration, we can now reduce the catchment of natural groundwater.

Arjen Kok:(Q) Is the infiltration capacity of this open infiltration system still good?
(A) Because the treated wastewater is very clean, there is no fouling effect in the dune sand.

Piet Veel: (Q) Why is chosen to have an open infiltration as well? Is the result of the Reversed Osmose (RO) treatment not clean enough to produce drinking water straight away. (A) (Soil)infiltration has been chosen for double safety reasons. Another benefit is that the hydrological system provides an additional buffering.

(Q) Does the EC-Habitat Directive hinder this kind of infiltration-system? (A) No, not for this area. However, since the dune habitat is not a fixed habitat and since it is changing all the time (also through human impact), the rigid Habitat Directive might be contra-productive for a changing nature. When you do not intervene in a dune habitat system, it will change in a monotone forest-dune.

Marleen Vandewalle: (Q) Was it difficult to get a permit to infiltrate the treated effluent into a dune area? (A) First, the water supply company got a permit for infiltration in which quality standards for the infiltration water had been stipulated. Using effluent as source water did not complicate that, compared with those standards. Moreover, there is no contact between the infiltrated water and the surface water outside the dune area.

Conclusion

When the natural hydrological system has already been affected, artificial recharge of treated waste water in dune ecosystems can be given a chance. For hydrological 'natural' dune ecosystems it is not advisable. Where it comes to EC legislation, it is felt that a more dynamic approach of the Habitat Directive could be beneficial in sufficiently large dune areas to get more recharge programmes of treated waste water accomplished. It is argued that the dune system is not a fixed habitat either.

4. Is knowledge of the fresh-water situation crucial for (re)creation of salt marshes? *(based on introductory statement 3)*

Discussion

Piet Veel: (Q) Is fresh water knowledge needed to understand the hydrological system of salt marshes? (A) The ecohydrological value of most of the salt marshes is based upon a gradient from fresh via brackish to salt (ground)water. So also the knowledge of the role of fresh groundwater is essential.

Conclusion

Knowledge of the fresh-water situation is crucial for (re)creation of salt marshes.

5. Will a good quantitative estimation of evapotranspiration of various vegetation types lead to changes in dune management?

(based upon introductory statement 4)

Discussion

Luc Geelen: (Q) Shrub development in dunes is one of the causes of lowering the groundwater table. Does that mean that shrub removal can be used as a management tool to restore groundwater table in dune slacks? (A) Indeed, measurements show that shrub has a much higher evapotranspiration than low open dune vegetation (grey dunes).

Piet Veel: (Q) Is also looked at seasonable effects? What happens after the growing season? (A) The values of evapotranspiration given in the presentation are values for the growing season only. During wintertime, some shrub species will keep their leaves. Shrub evaporation outside the growing season will thus also be higher than evaporation from the herbaceous vegetation.

Laurence Boorman: (Q) How much of the lowered groundwater table is restored by removing the shrub/reducing the evapotranspiration? (A) This effect has not been measured/ calculated. But the bigger the area where you remove the shrub, the more effective the decrease of evapotranspiration will be. Changing small patches of shrub won't work.

Luc Geelen: (Q) Has a distinction been made between wet and dry vegetations, because plants are reacting differently when they experience 'water stress'? (A) Vegetations growing at different water table depths were used for calculating the evapotranspiration. However, none of the selected plots experienced drought stress during the experimental period. Plants would indeed react to drought by lowering their transpirational losses.

Conclusions

The removal of shrub out of the dunes is not only important for ecological reasons, but also for hydrological ones. By decreasing the evapotranspiration, more water can infiltrate into the dune soil. The result will be a higher groundwater level in the dunes.

Workshop 4 – Tourism/recreation and nature restoration in coastal dunes

Chair: Haim Tsoar[1]
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Introductory statements *(for full-text articles see Proceedings)*

1. The Abbey of the Dunes (Koksijde) and Noordduinen: the environmental link restored (*Van de Steene* et al.)
2. The opening to the French public of 'natural' sites of coastal dunes: the choice between 'over-visiting' and 'over-protection' of a shared natural heritage (*Meur-Férec and Favennec*)
3. Ecological aspects of vegetation removal from the coastal sand dunes of Israel (*Tsoar* et al.)

Major questions/provocative statements

1. Should we limit the number of ***people visiting the coastal dunes*** or should we restrict people to certain zones?

2. How can we preserve ***high-water drift lines*** and hence stimulate the development of embryonic dunes, without interfering with the recreational function of the beach?
3. Should we be afraid of ***shifting sand***? Should we ***remove the vegetation*** and turn the artificially stabilized coastal dunes into active ones?
4. How can we ***harmonize historical/archeological/cultural landscape*** conserving activities in dune areas and estuaries with nature restoration?

Discussion/answers to questions

1. Should we limit the number of people visiting the coastal dunes or should we restrict people to certain zones?

Sub-questions

Is trampling a problem? Yes for flora, but what about fauna? What to do about education (visitor centers, excursions)?

Discussion

It is important to make a distinction between local people and tourists from outside the area when we want to change habits. Local people have certain traditions (and traditional rights) and will not accept restrictions that external visitors may accept easily. On the other hand, it depends on the countries, the importance of the sites and on the extent of the sand dunes area. In vast 'wild' dunes we can give the visitors some liberty to walk around. In urban dunes (such as those of Belgium) we must enforce restriction, fence the area and guide the public. Dune Parks can be used for education ('ecological gardens'). Policy of access is a question of both biodiversity and social matters. Are we going to improve biodiversity if we close the area? In the Belgian dune area the Westhoek, there was a change in the public habits over the past few decades. The area is no longer freely accessible these days, although several paths cross the area. More people are visiting the Westhoek today than before. What they see from the path is 'undisturbed' nature. Therefore, they want to keep staying on the path.

Many think that some perturbation is necessary in order to get dune dynamics. In each region we want a dynamic landscape. More and more ecologists and managers are recognizing the value of coastal dunes as a dynamic landform and became aware of the important effect of disturbances on the landscape and on the communities in the landscape. Some trampling can be useful as a management tool. In other parts (for example with climax vegetation) trampling cannot be accepted.

15-20 years ago people didn't appreciate the importance of the sand dunes. Experiencing nature is important, also for educational purposes. Public awareness is increased by education. For this and other reasons, an intelligent zoning – in time and space – is needed. For instance infrastructure (parking lots, tracks) is compatible with areas where strong recreation pressure can be allowed. In various Dutch dune areas (e.g. National Park Zuid-Kennemerland, Terschelling,…) there are access points with lots of

possibilities and quiet zones with restrictions. Tourists can also be influenced by the design of the infrastructure. The dunes of Flanders are probably too busy for birds to breed.

Conclusion

Restricting access for people to certain dune areas, can be a useful tool in balancing biodiversity and social needs. People should be limited in certain areas while other areas should be closed during the breeding season. This zoning is also different from place to place, and can change over time.

2. How can we preserve high-water drift lines and hence stimulate the development of embryonic dunes, without interfering with the recreational function of the beach?

Discussion

In Germany there are locations with small beaches and fenced dunes. People stay in front of the fence. The drift line is within the fenced zone, so the embryonic dune zone is protected. In France the main problem is the intensive mechanical cleaning for tourism, taking away all organic material and destroying eventual newly formed embryonic dunes. Although it is evident that it is necessary to clean beaches from plastic debris etc., more and more people realize that the natural beached organic material should not be removed always and everywhere. In the Gironde (France) for instance, the financial support by the 'Conseil général' for the non-selective mechanical beach cleaning (50%) is lower than for manual, selective cleaning (80%). As a consequence, cleaning operations are changing. Moreover, less 'clean' beaches are accepted, as long as it refers to organic litter. Also education took place, with a look on the ecology of drift lines. Near the cities, the war is lost, but in between the cities there are some possibilities for success. Changes can also be seen on a beach that is closed for 2-3 years as it was at Stefton, England. At Heist (Belgium) people can now see the difference between the recreational beach and the vegetated, fenced beach nature reserve. In Koksijde (Belgium), near the sea-site resort, the beach is completely cleaned but there is a section with manual cleaning. Small parts are fenced to show what the effect of the restriction of trampling is. At the start this caused a lot of trouble, but now it seems that some equilibrium was reached. That brings us back to the question of zoning. There should be zonation where each zone has a different function. However, there is some danger in zonation, especially when the beach is mobile. We have to learn how to plan mobile zones.

Conclusion

High-water drift lines can be preserved, and hence the development of embryonic dunes, by protecting them from non-selective, mechanical beach cleaning. This can be achieved by applying a zoning (e.g. by restricting mechanical, non-selective beach cleaning to the

most visited beaches and the summer period) and by taking into account the various uses of the beach.

3. Should we be afraid of shifting sand?

Sub-question

Should we turn vegetated stabilized dunes into mobile dunes?

Discussion

The response to this question is linked to the way of thinking of a certain period. There is also a political response. Local communities respond differently than policy makers. We have to find out what is acceptable. Who is afraid? This depends on the specific interests people have. In Belgium some measures had to be taken when shifting sand became a real, local problem (e.g. a house near Koksijde started to be covered by sand). In the Westhoek dune reserve, the 'desert' (an open sandy area) is loved by the public, and it is not considered to be dangerous. The opposite is true with tourists being alarmed that the Westhoek starts to stabilize. A positive attitude is also possible if there is no direct danger. Shifting sand gives some 'wild' thing that the people like. In the Netherlands there are some small areas with spontaneous blow-out activity, close to villages. The inhabitants there are annoyed with the shifting sand, so in that case the sand is being stabilized. In another Dutch example, people living 3 km from a mobile dune complained about sand on their roofs. It may take many years until people realize the value of shifting sand.

Conclusion

The way people feel about shifting sand in dune areas depends on many things. Open sandy areas with shifting sand are often appreciated as 'wild' nature, a positive attitude that is linked to the fact that the people concerned do not experience any threat. However, when sand reaches nearby houses, the inhabitants often feel annoyed and ask for measures to stabilize the shifting sand. The main conclusion seems to be that, where possible, shifting sand should be allowed, compensating for areas where local hinder requires stabilization of dunes.

4. Shall we remove the vegetation and turn the artificially stabilized coastal dunes into active ones?

Sub-question

Artificial stabilization is now considered as wrong management. Do we need to repair it?

Discussion

There is also a change within the attitude of foresters. They begin to accept that a forest is not necessarily the best site in terms of biodiversity, and that stabilizing dunes may counteract the conservation of biodiversity. The public should be informed that maintaining a range of succession stages in vegetation (from open shifting sands towards afforested areas) is the best guarantee to preserve the entire ecosystem. Shifting sand can be a tourist attraction and is part of the dune system. But turning everything into open sandy areas will lead to a loss of biodiversity (on top of local inconvenience).

We don't know whether the artificially stabilized dunes were artificially destabilized before. Hence, the important question is if the remobilization can be durable. If it is durable, then why are the Westhoek dunes in a process of natural stabilization now? The Dutch experience teaches us that it can be durable if some kind of maintenance managements are accomplished at least for the first 5-10 years.

Many plants need input of fresh sand. Disturbance by tourists can be used to achieve this, although it also depends on the scale of the dynamics. Moreover there is a problem of connection with vulnerable parts, where you don't want any trampling. How can you zone it? Small scale dynamics can be created by walking people. On the other hand we have to be careful with trampling for dynamics. It can also lead to landscape destruction (small blowouts).

Conclusion

The main question is how to achieve a proper, sustainable management of dune areas in which biodiversity is protected and stimulated in an optimal way, tourists are allowed to enjoy the landscape – where possible – and management actions can be restricted as much as possible.

5. How can we harmonize historical/archaeological/cultural landscape conserving activities in dune areas and estuaries with nature restoration?

Discussion

In the Netherlands, the so-called 'Zeedorpen' dune landscape, is considered as being an important cultural heritage and has therefore been restored in some places (e.g. by allowing small scale agricultural activity, by restoration of dune slacks,…). In this restoration process of special historical landscapes, here and in other places, it is advisable to harmonize the historical, archaeological, cultural and ecological values as much as possible. Therefore, in case of restoration, we should always make an archaeological inventory. Another example of a special historical coastal landscape is the Atlantic wall, a series of bunkers and other fortifications from the Second World War along Europe's coastline. Here, one can choose to destroy only those bunkers that pose a threat to the public, but conserve e.g. bunkers as a valuable habitat for bats or lizards.

Conclusion

Particularly in restoration processes of special historical coastal landscapes, it is important to harmonize the historical, archaeological, cultural and ecological values as much as possible. This can be achieved by carefully planning the restoration process, and taking into account all available information from various points of view.

Workshop 5 – Nature restoration/development in harbours: coping with the Birds and Habitats Directives

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Introductory statements *(for full-text articles see Proceedings)*

1. Management Plans in perspective of article 6.1 of the Habitats Directive: a common interest binding fishermen, ecologists, hunters, port planners and recreationists (*Neumann*)
2. Maintenance of the favourable conservation status in two Special Protection Areas in co-habitation with development of the Antwerp harbour (*Spanoghe* et al.)
3. Tidal wetland restoration at Ketenisse polder (Schelde Estuary, Belgium): developments in the first year (*Van den Bergh* et al.)
4. Nature restoration in the harbour of Rotterdam, the Netherlands (*Zindler* et al.)

Major questions/provocative statements

1. With regard to an unanticipated colonization of harbour areas by species qualifying for Birds- or Habitat Directives (BHD), should the possibility be created to ***exclude areas from jurisdiction of these BHD***? And is it recommendable to change the EU-directives to facilitate initiatives by port authorities and industry to ***temporary set aside areas*** with a high natural potential?
2. Compensation measures should start five years before a harmful effect of a proposed plan/project is expected. ***Conservation banking*** (acquisition of areas in advance, to be used for restoration/compensation in the future) has the future.
3. Quantitative ***conservation objectives*** are preferable over qualitative objectives.
4. The EU should enforce a specified ***monitoring scheme*** with regard to the Bird- and Habitat Directives.

- Are there specific natural values in harbour areas that should get priority in the conservation objectives for these areas? For instance, harbour areas are relatively

favourable for pioneer species and migrating fish species (ships and fish both need channels without barriers).
- How to interpret jurisprudence about significant effects? A recent ruling by the EU Court about the Dutch Cockle Fisheries in the Wadden Sea has been interpreted in the Netherlands as: there is an effect, unless one proves there is not. How do other countries deal with this issue?
- In finding agreement between the conservation objectives of the Bird and Habitats Directive and the goals of the Water Framework Directive, what should get priority: improving water quality or habitat restoration? Or better: can they be combined in harbour regions?

Discussion/answers to questions

1. Regarding 'unanticipated colonization by species qualifying for birds or habitats directives': introduce the possibility to exclude areas from jurisdiction of Birds and Habitats Directives

Explanation

The question is: how to reconcile industrial development and an increase in EU-qualifying species in newly-developed harbour areas? Large areas in developing harbours are quiet and activities that do occur are predictable. The substrate is often sandy with moisture and salt gradients. As a consequence, land that is not in use yet is often colonized by rare species, in particular pioneer species. That may imply new designations and higher conservation objectives. Port authorities and industry are therefore reluctant to accommodate this development, afraid as they are that the Bird and Habitats Directives (BHD) will restrict further industrial development of these sites. These new settlements may be viewed as an extra bonus, on top of the natural values that are already protected through the conservation objectives. Some species are quite mobile; thus, they will probably move to other sites when the locations where they have settled will be given over to industrial activities, as planned.
The introductory statement 4 presents some interesting examples from the harbour of Rotterdam ('clay factory', ploughing under of orchids on pipeline and cable sections). The Port Authority was nature-minded, but that has changed because of BHD-new nature-problem.

Discussion

If you are going to exclude areas from the BHD in port areas, you will also have to do that in other areas (e.g. agriculture, military).

In the Netherlands, the present formulation of the Flora and Fauna Act is very strict with respect to the protection of areas that have been colonized by such species. It is hardly possible to force species out. Comparable law in Flanders leaves more room.

It is contradictory to the BHD, in which continuous designation of new areas (and dropping other ones that no longer meet the criteria) is an important ingredient. Thus, exclusion would go against the Directives.

Conclusions

It is important to define precise relatively high (to accommodate possible new colonisations) conservation objectives, and designate a large area for these objectives. That gives you certainties and flexibility, important for industry, and more nature than you would have with the 'old' conservation objectives that do not take into account possible new colonisations. These new conservation objectives would also have to include objectives for species that are not present in the area yet, may even never have been present there before. In the management plan it can be specified that a certain area (e.g. 5%, without specifying the exact locations, they may vary in time) is allocated to such new developments. Within this area dynamic planning can be part of the management, while meeting the objectives is guarded by a network manager (often the port authority).

This concept is particularly useful for mobile pioneer species such as coastal birds. For species such as orchids the Management Plan should be location-specific.

It is not a solution to focus only on the national perspective and allow deterioration in a specific SPA/SAC because it does not affect the national objectives, for instance because it is counterbalanced by an improvement in another SAC/SPA. Each country is responsible for reaching a favourable conservation status for each SPA/SAC that has been designated.

2. Compensation measures should start five years before a harmful effect of a proposed plan/project is expected

Explanation

When to start with compensation measures? The EU requires that compensation measures become effective at the moment that the project for which the compensation is necessary will start to affect the qualifying species or habitats in the area. However, countries often do not comply with this clause. And even if the planning, land acquisition and construction are carried out in time, the necessary soil development, species colonization, population growth and vegetation succession will take time. In other words: the implementation by national governments of the present requirement in the Directives about the timing of nature compensation is too lenient/soft. There is also increasing evidence that compensation is often only partly successful.

Discussion

It is an illusion that projects are going to wait for the definition and execution of proper compensation plans. Therefore, go with the flow: adapt.

It is important to discriminate between species/habitats: for some species/habitats five years will be enough, others need much more time.

The general conclusion was that compensation measures should be started as far in advance as possible. This led to a discussion on **habitat banking and conservation banking**. Habitat banking is always connected to a specific plan or project, and is therefore initiated by the party that wants to carry out that plan or project. Habitat banking has a bad reputation, because of the way it has been discussed and proposed in the past: as a confusing array of shifting compensation locations, shifting objectives (compensation, restoration, mitigation) and a tendency to use it as an excuse to skip appropriate assessment.

Also, advance planning of restoration measures should not be tied to a specific proposed plan or project, but had better be based on the conservation objectives of a certain SAC/SPA: how can we improve the structure and function, make nature more robust?

Recently, a new concept has therefore evolved, under the name 'conservation banking'. Conservation banking means that: (1) the local or national government (instead of the initiator of a proposed plan or project) defines a restoration plan that; (2) is not connected to a specific proposed plan or project but that; (3) specifically aims to improve the SAC/SPA to a level higher than the conservation objectives. The idea is that compensation may not be necessary with such an approach, or is covered by restoration measures that are part of a conservation banking scheme.

Conclusions

*Conservation banking is a promising line of thinking, as long as it is firmly based on/closely tied to the conservation objectives **and** the normal procedures of the BHDs are obeyed, such as appropriate assessment. The latter is important since compensation should only be considered as a last resort, legally/formally, but also ecologically for the very reason that it appears that compensation is often not sufficiently effective.*

3. Quantitative conservation objectives are preferable over qualitative objectives

Explanation

Qualitative: maintain or restore habitat type x. (in fact, this is semi-qualitative, because of the word 'maintain'). Quantitative: 300 ha of habitat x, or 30 breeding pairs of species Y.

This subject is of particular importance in discussions among member states about conservation objectives for areas close to their mutual border. A state with very specific conservation objectives for species or habitats that are dependent on conditions in a neighbouring country may run into problems when that neighbouring country has very wide conservation objectives.

Discussion

It is generally agreed that conservation objectives should be quantified as much as possible. With quantitative objectives, industry and conservationists know what to aim for, what to take into account. It prevents endless discussions and allows more accurate planning by port authorities/industry. Quantitative objectives also allow a good evaluation of restoration measures. Finally, quantitative goals are also necessary to be able to determine whether you reach your national goals.

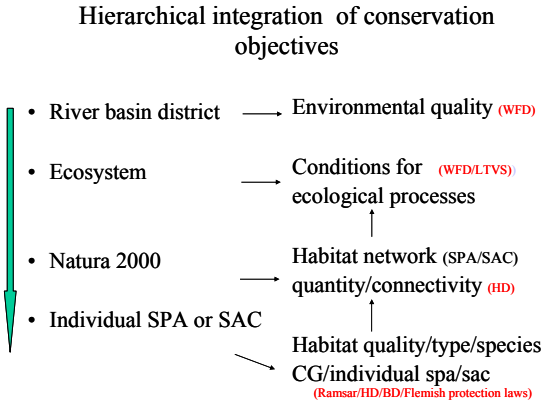
However, there are also arguments against quantitative goals:

1. there is often insufficient knowledge on ecosystem functioning to determine meaningful quantitative goals. You need to understand the structure and function, the underlying processes;
2. such quantitative goals may be against the nature of an evolving ecosystem, as may be present in an estuary;
3. with respect to goals for (migratory) species: the size of the local population often depends on conditions elsewhere.

Conclusions

The definition of quantitative goals in terms of underlying physical, chemical and biological processes is the ideal. It has the advantages of quantification and does justice to the dynamic nature of many estuaries.

Harbours in estuaries are subject to several juridical commitments (Water Framework Directive – WFD, BHD, local (inter)national initiatives), each with its own objectives. A promising approach is to set goals in an integrated, hierarchical approach, starting with (1) the river basin district (WFD), via the (2) ecosystem/Natura 2000 netwerk-level to (3) the individual SAC/SPA. An example of such a scheme has been applied to the Scheldt Estuary (and has as such been adopted by the Flemish Government).



It starts from an ecosystem view and sets objectives on all levels that are necessary to guard a full functionality of the ecosystem. This can be processes as well as habitats or species. Objectives should be set on all levels, but can in some cases be translated into objectives at a higher level.

The same applies to restoration measures: they should not be aiming at restoring specific populations (example: creation of nesting islands) or habitats, but at restoring the physical processes that generate the required habitats and populations of species.

4. EU should enforce a specified monitoring scheme

Explanation

The effectiveness of nature compensation measures is often limited. Also, restoration measures are in fact large-scale experiments that can lead to a better ecological understanding that can be used for other measures. Both arguments call for good monitoring. The EU-Directives are not specific with respect to monitoring. They do require that the countries show whether their measures are effective with respect to the conservation objectives, but monitoring is often low on the list of priorities of national or local government. Should we recommend to the EU that specific requirements with respect to monitoring are incorporated in the Bird and Habitats Directives? Which requirements would that be?

Discussion

There is a general agreement in the audience that some sort of specified minimum monitoring requirement should be included in the EU directives. Monitoring of both habitats/species and underlying processes (erosion/sedimentation, etc.), and *long-term* monitoring is called for.

Ideally the integrated hierarchical conservation goals, from which goals can be drawn for each individual juridical commitment, should be accompanied by a fitting monitoring program. The results of the latter should be published in evaluation reports for each of the legal commitments. This would be very cost effective and optimize standardization of monitoring methods. However integrated goal setting and monitoring requires integrated efforts across ministries and administrations. Often, divisions within a government (e.g. ministries) only want to be responsible for the monitoring of the results of a plan/Act for which they are responsible and are reluctant towards integrated approaches.

Conclusions

A full-time coordinating team is a key-factor for the success of management plans and integrative monitoring.

An international monitoring scheme might be very cost effective. For instance: it would be possible to select representative sites/projects for detailed monitoring, and to implement less intensive monitoring in other sites (less intensive, but sufficient to report to the EU about the conservation status). That might be cheaper than if each country develops it own monitoring scheme.

Workshop 6 – Shoreline management

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Introductory statements *(for full-text articles see Proceedings)*

1. Morphological evolution and management proposals in the Authie Estuary, northern France (*Dobroniak*)
   A good example of an estuary that poses a number of severe management problems, notably estuarine shoreline protection, and that calls into question the very survival of the estuary itself. The Regional Authority has been aware of these problems and undertook a study on estuary restoration, trying to define the best long-term strategy. The awareness of the socio-economic and the environmental values of the intertidal zone gave rise to recommendations for an integrated management of the Authie, especially the interaction between the environment and the shellfish farming ecosystems.

2. Restoration of intertidal habitats by the managed realignment of coastal defences, UK (*Garbutt*)
   Through examples from the UK, a new perspective on estuarine policy was presented. The past coastal defence position is now moved using very different criteria that leaves new free space for the estuary. The new intertidal zone will be naturally covered by water and sediments first and by saltmarsh plants and organisms afterwards.

3. How may beach nourishment affect the sandy beach ecosystem? The case of Belgian beaches (*Speybroeck* et al.*)*
   Awareness about the implications on beach ecosystems resulting from artificial nourishment was highlighted. Nourishment of beaches is mainly used as a measure for coastal protection but in some cases nourishment can also be applied to restore the natural value of the beaches. Nevertheless, a serious (short term) ecological impact must be expected. After a study of the Belgian beach ecosystem conducted by a consortium of experts, a first evaluation of the ecological impact of beach nourishment was made. However, specific studies are needed to help with management guidelines about preferable nourishment sediment characteristics, timing and methodology of the sand deposition.

4. Sustainable estuary management for the 21st century (*Morris*)
   Since more than 200 years many British estuaries have been channelled and filled with infrastructures, many of those being so old now that coastal managers are seriously considering if it is worthy or not to restore them. It was argued that there is a need for a change in the management of the estuary shape, the flood defence design and the maintenance of other coastal structures that influence the morphological evolution. This needs a radical departure from popular thinking that existing structures should be maintained *in situ*, though incompatible with climate change and sea level rise. For sustainability at long-term, solutions need to be radical, and require a degree of foresight and bravery as decisions may have to be made in the face of serious local opposition. To make such decisions more socially and economically viable, solutions must not focus solely on nature conservation outcomes, but must seek to deliver the most morphologically sustainable form from the mouth of the estuary to the tidal limits and beyond.

Major questions/provocative statements

1. ***Coastal flooding of wetlands*** in a ***sea-level rise scenario***: conventional defence approaches or conservative and (re)naturalizing solutions?

2. ***Restoration of intertidal habitats*** from agricultural land: towards the opposite alternative of the old reclamation (poldering) approach? Which are the socio-economic impacts?

3. ***Estuaries' survival*** in face of continued sea level rise: are there any good solutions? Which are the less harmful alternatives? How can a sustainable development, considering all the involved parts, be achieved? How will be the future of estuarine cities?

4. ***Coastal dunes facing sea level rise*** and increased storminess: which options should be considered in the EU ICZM, concerning the conservation of this so important but fragile natural patrimony?

5. ***Beach nourishment*** on an ecological perspective: what will be worst for biological communities? (1) the loss of sand resulting from a negative sedimentary balance and the establishment of new natural (re)equilibrium, (2) the implantation of defence structures downdrift (e.g. groins) to promote the building of wedge beaches, or (3) the renourishment with imported sands from elsewhere?

Discussion/answers to questions

From the general discussion, the following main conclusions can be made.

Conclusions

Climatic changes and their consequences such as sea level rise are inevitable. During the last years, dramatic changes have been occurring worldwide, most of them with heavy social and economical impacts. The case of New Orleans, USA, last year, was given as an example of the human vulnerability when confronted with natural disasters.

The engineering solutions against coastal erosion and for sea defence that were long believed as the right ones, must be re-evaluated as they are very costly and inadequate to contain natural disasters in the future. The case of the Delta project in the Netherlands, was cited as an example of a very costly and unmanageable solution. Fixed set back lines are not sustainable and are very expensive.

To acquire coastal areas for gaining coastal resilience is expensive at short-term, but no more so than engineering defence structures that in addition to their costs, need periodic maintenance and have many negative impacts. The case of the 'Conservatoire du Littoral' in France was given as a good example.

Scale is very important in the approach of the coastal issues. Short, medium and long (temporal and spatial) scales of an issue are very different. Large and international estuaries cannot be considered in the same way as local small harbours. The economical perspective of large, international harbours, are the concern of several countries (or the whole EU), so the role of big companies as stakeholders at an international level should be accounted for in an economic perspective.

The time for change has arrived. There is a need to replace old concepts about hard engineering to soft, sustainability engineering, based on conservation practises. The perception of a natural global change scenario and the improved understanding about coastal processes, imply a trend to ecosystem approaches and wise application of knowledge to more sustainable coastal approaches. However, social impacts on local communities must be considered. So, a correct long term cost-benefits analysis is fundamental. Disaster funding are also very important economic skills for local communities, obliged to change life styles.

Despite its impact, artificial nourishment to fight against coastal erosion and loss of beaches, should be preferred to engineering defence structures which are much more harmful.

It is fundamental that all the involved coastal actors from different countries arrive to imaginative solutions so that societies can pick them up and include them in their plans, projects and management issues. There is not a single good solution. Compromises on a case-by-case basis and with the involvement of local communities are needed. It is important to have an international policy but also to take into account local issues. Coastal zones are not the same everywhere. The involvement of communities and the quality of the local policy are of the highest importance.

It is time to change and to move to conservation approaches. No more defence structures, no more abuses, and no more repeated mistakes. We need to learn from natural coastal dynamics, while it is still time!

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